July 3, 1951 C. B. PIERCE 2,558,979

INTERNAL-COMBUSTION ENGINE LIQUID FEEDING SYSTEM

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FIG. 1.

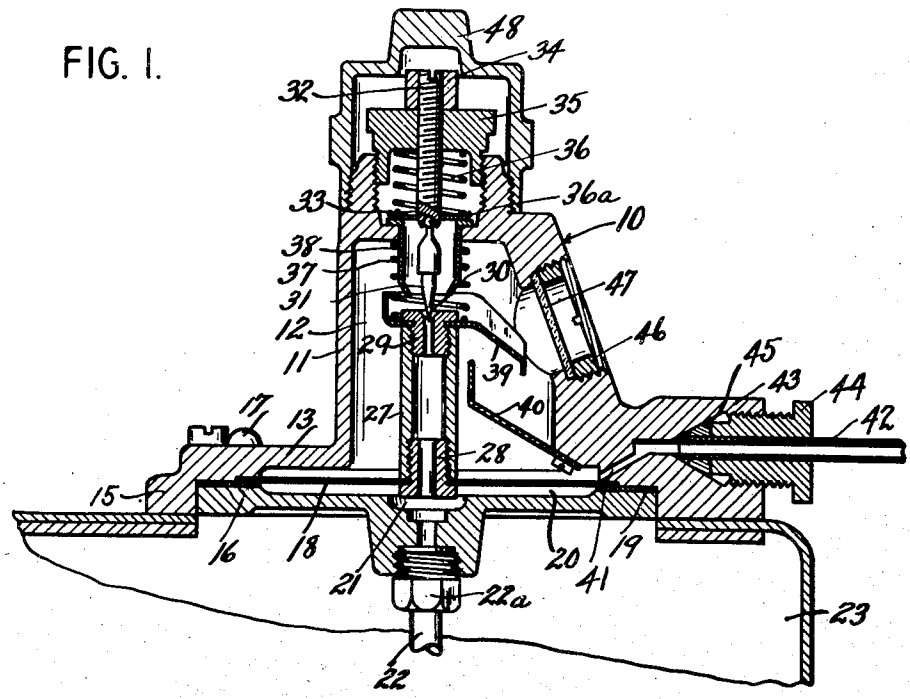


FIG. 2.

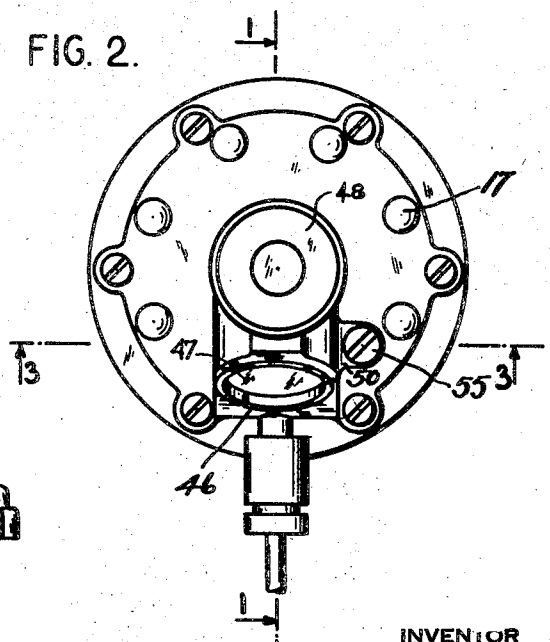
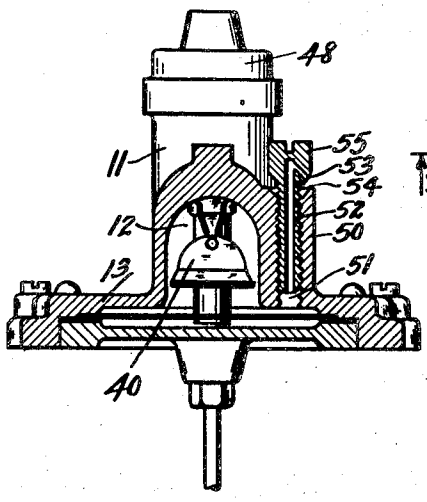


FIG. 3.



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INTERNAL-COMBUSTION ENGINE LIQUID FEEDING SYSTEM

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6 Claims. (Cl. 123—119)

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This invention relates to a liquid feeding or metering device for internal combustion engines and particularly to such a device which feeds liquid material to the engine in accordance with its operating requirements.

The invention operates generally in the manner shown in U. S. Patent No. 1,883,110, although the instant invention is not intended to be confined to lubricating systems. As disclosed in this patent, such a device includes the provision of a movable diaphragm which is acted upon by a vacuum existing in the manifold of the internal combustion engine so as to adjust the opening of a needle valve and to control accordingly the quantity of liquid such as oil, fuel or any other like fluid which is to be delivered to the combustion chambers of the engine through the valve opening. The device is arranged to thereby increase the effective size of the valve opening when the engine is running under load so as to correspondingly increase the passage of the liquid to the engine. Conversely, the effective valve opening is decreased when the engine is idling and the passage of liquid being delivered is limited accordingly. Thus, the system serves to supply an amount of liquid governed by the speed of the engine. As to the type of liquid that may be employed, it may be generally stated that lubricating oil, kerosene, petroleum base solvents, or even water may be used according to specific requirements. The above liquids are selected depending upon whether lubrication, cleaning, motor tune-up or other treatment is to be effected.

In producing a device of such type, it has been the practice to set the valve opening in accordance with an indicia wheel effectively connected to the valve. Vacuum from a bench test apparatus was employed and the valve opening was preset accordingly. A user of the apparatus, after proper installation, would make further adjustments by turning the indicia wheel while the engine was idling until the liquid oil was fed at a slow, predetermined rate. The user was guided by either figures on the indicia wheel or by counting the liquid drops as they were fed to the engine. Generally, and in the case where lubricating oil was being used, about 3 or 4 drops per minute flowed at engine idling speed and the user then assumed that the proper flow, i. e. about 40 or 50 drops per minute, would flow at high speed. Thus, the high speed condition was a factory adjustment while the low speed was a local or environment adjustment. By the term "high speed" I refer to operation of the engine under its load such as the pulling of a vehicle. It is the high speed condition which is generally important since it is at that time that the lubrication or other treatment is of most benefit. The adjustments were therefore generally inadequate. The ultimate user could not conveniently make a high speed because the car or other vehicle would have to be running and the

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engine properly under load. On the other hand, the factory adjustment was generally unsatisfactory because it did not truly represent the operating conditions of any particular engine. Thus, different engines generally produced different degrees of vacuum and a standardized bench test adjustment, while it was of definite value, did not necessarily produce an accurate flow of liquid when the device was installed and operating.

Bearing the foregoing in mind, it is an object of the present invention to provide means whereby a liquid feeding device of the above character may be easily and conveniently adjusted by a user thereof under conditions simulating load operation of the engine with which it is associated. According to the present invention, the user may operate the engine at idling speed and the device may nevertheless be subjected to a vacuum which corresponds substantially to the vacuum which would be produced were the engine to be operated at high speed and under load. Adjustment of the device may be made during this test period and the device may then be restored to its normal state so that when the engine is run at high speed thereafter, the liquid will flow at substantially the same rate as that observed during the test adjustment at idling speed.

Other objects of my invention will be apparent from the following description, it being understood that the above general statements of the objects of my invention are intended to describe and not limit it in any manner.

Referring to the drawings:

Fig. 1 is a vertical section of the liquid feeding device as taken along the lines 1—1 of Fig. 2.

Fig. 2 is a top plan view thereof on a reduced scale.

Fig. 3 is a sectional view along the lines 3—3 of Fig. 1.

The device comprises a casing or housing 10 having a substantially tubular wall 11 defining a chamber 12. Wall 11 is formed with a perpendicular base 13 which is provided with a depending flange 15. Flange 15 is adapted to embrace an enclosing floor 16 which is secured therein by screws, not shown, which are receivable into the dome-like nuts 17. Secured between the marginal edge of floor 16 and base 13 is a circular diaphragm 18 tightly maintained therebetween at its marginal edge and provided with a gasket 19. Floor 16 is formed with a central annular depression so as to provide a narrow chamber 20 on the underside of diaphragm 18. Thus, diaphragm 18 operates between the chambers 12 and 20 as hereinafter described. An opening 21 is formed centrally of floor 16 and serves to receive a conduit 22 through the medium of adaptor nut 22a. Conduit 22 communicates with the source of supply maintained within can or reservoir 23.

As will be hereinafter described, diaphragm

18 is adapted to be acted upon by suction conditions of an internal combustion engine to which the device is applied so as to control the size of a valve opening through which the liquid flows to the engine cylinders. Thus, diaphragm 18 is connected to hollow stem 27 as by a hollow brass nut 28. Screwed into the upper end of stem 27 is a hollow nut 29 providing a valve seat 30. Valve seat 30 cooperates with a needle valve 31 in order to determine the size of the valve opening, as will be evident.

Means are provided to determine the normal relationship of needle valve 31 with its valve seat 30. Such means comprise a screw 32 supporting the valve 31 through a knuckle joint 33. Screw 32 is threadedly received within the nuts 34 and 35, the nut 35 serving as an adjusting dial which, in previous embodiments, was provided with indicia for indicating the longitudinal position of valve 31 and consequently supplying information as to the size of the valve opening. In the present embodiment, such indicia is unnecessary, but nut 35 may be supplied with an arrow or any other means to indicate which direction of turning lowers or raises the valve 31. Nut 34 serves primarily to provide an initial, factory adjustment whereas nut 35, as hereinafter described, is turned during final adjustment by the ultimate user after the device has been installed on an engine. It will be evident that rotation of either nut 34 or 35 will vary the longitudinal position of valve 31 accordingly. Cap 48 may be unscrewed and replaced as desired during these adjustments. A coil spring 36 disposed within a hollow of nut 35 serves to maintain the parts in correct and firm relationship and has as one terminal therefor plate 36*a*. A coil spring 37 similarly stabilizes the valve enclosing cup 38 against the feed spoon 39 and maintains the stem 27 against undesired lateral movement.

Feed spoon 39 serves to receive the liquid as it emerges from the valve seat 30 and permits the liquid to drop onto the pan 40. The liquid thereafter is drawn through orifice or port 41 into the conduit 42 which is maintained within the internally threaded nipple 43 by the coupling 44, a circular grommet or gasket 45 serving to provide a tight connection. A ring screw 46 provided with a glass window 47 affords visual communication with the chamber 12 so that the amount of liquid dripping from spoon 39 onto pan 40 may be observed. Thus, the adjusting means provided by nuts 34 and 35 may be actuated pursuant to the observed flow of liquid during the operation of the engine.

The other end of conduit 42 extends through a suitable opening formed in the intake manifold of the engine between the intake valves and the throttle valve of the charge forming device in the engine. In this manner, the upper chamber 12 is subjected to the suction of the engine so as to actuate the flexible diaphragm 18, such actuation taking place between the upper or extended chamber 12 and the relatively shallow chamber 20. It will be recognized that as the diaphragm is drawn towards the needle valve 31, the size of the valve opening decreases to reduce the amount of liquid drawn from the source of supply to the combustion chambers and valves of the engine. The operation of the device is such as to produce a larger opening of the valve means when the engine is operating at high speed conditions and reduce the size of the opening during low speed operation.

In producing the device, it was formerly the practice to position the needle valve 31 at the factory by applying a screw driver to the slotted upper end of screw 32. This adjustment was made until the indicia on nut 35 was rendered more or less accurate for each specific device. The adjustment was made by introducing a vacuum to the chamber 12 which was intended to simulate the vacuum produced through the operation of an internal combustion engine. Such test vacuum was introduced through the orifice 41 in the same manner that it would be introduced when in actual use. It was estimated that a conventional engine would produce a vacuum of approximately 15 to 23 inches of mercury when the engine was idling and would produce a lower vacuum of about 3 to 7 inches when it was running at high speed. Accordingly, the test vacuum was of the same order. When a vacuum of from 3 to 7 inches was applied to chamber 12, the tester would observe the flow of the liquid through the window 47, the liquid flowing in drops from spoon 39 to the pan 40. Screw 32 might then be turned until 40 to 50 drops fell per minute. Thereafter, a vacuum from 15 to 23 inches was applied and screw 32 again turned, if necessary, to produce a flow of about 3 or 4 drops per minute. The device was then packed and shipped as being satisfactorily adjusted. As above stated, however, the method of adjusting was not satisfactory in that different engines required specific adjustment and the user could not make this adjustment unless the vehicle were running. It is obviously very difficult or impossible for an operator to adjust a device under the hood of an automobile while he is driving the vehicle. Accordingly, the instant invention makes possible the simulation of driving conditions while the engine is idling and the vehicle is standing still.

A boss 50 is provided as by the process of casting it together with the wall 11 and base 13. Boss 50 is hollow and internally threaded and its lower opening 51 communicates with chamber 12. Threaded bolt 52 is received into the hollow of boss 50 and is itself hollow so as to provide an air passage to chamber 12 through the hollow of boss 50. The upper end of the shank of bolt 52 is formed with an opening 53 serving as an extension of the central hollow of bolt 52. Opening 53 is downwardly inclined to avert dust which might clog it. Boss 50 is formed with a countersink 54 at its upper end which is adapted to receive the lower portion of the head 55 of bolt 52. When head 55 is screwed down, the opening 53 is received in the countersink 54 so as to seal off the chamber 12 from air through the bolt. Conversely, when the bolt is loosened, opening 53 has access to the outside air. It has been established that opening 53 may be in the order of .040 inch although it is to be understood that considerable deviation from this dimension will secure the results set forth hereinafter.

With the air vent provided by bolt 52, it is possible to simulate operation under load although the engine is idling and the vehicle standing still. During normal idling, as above stated, the vacuum approximates 20 inches. Accordingly, the diaphragm 18 is drawn upwardly so as to almost close the valve and only a few drops or even none at all will flow. The operator may, however, unscrew or loosen bolt 52 so as to relieve the vacuum in chamber 12. Accordingly, the vacuum will fall considerably

although it will still remain to a measurable degree. It has been found that with the opening **53** described and a port **41** having a diameter of .040 inch, the unscrewing of bolt **52** produced a vacuum in chamber **12** of from 3 to 7 inches when the introduced vacuum was from 15 to 23 inches. Thus, the operator, by unscrewing bolt **52** while the engine is idling, can produce a vacuum state in chamber **12** which approximates that which occurs when the engine is running under load. The operator need then merely turn nut **35** until he observes that liquid is dropping at the rate of 40 to 50 drops per minute, or any other desired rate depending upon the specific liquid used or the size of the engine. He then tightens bolt **52** so as to restore the device to its normal operating state. Immediately the diaphragm **18** will be drawn so as to reduce the flow during idling periods whereas the flow will be at the higher rate when the engine operates under load. In this manner, the factory adjustment is considerably simplified, if not substantially eliminated, and the operator of the vehicle has no further need of consulting the indicia, if any, on nut **35**. The adjustment which the operator does make is truly made under conditions which simulate the action of the particular vehicle at load operation. It will be evident that the dimensions above given may be considerably varied, it being the principal objective to produce a vacuum in chamber **12** of from 3 to 7 inches by loosening bolt **52** when the introduced vacuum is from 15 to 23 inches. The actual low vacuum achieved by loosening the nut may be proportional to the introduced vacuum according to this example.

It will be observed that nut **35** is externally accessible in that its actuation does not interfere with or disable the apparatus. Accordingly, the adjustment of external bolt **52** may be made under operating conditions of the device. Such adjustment is made, of course, in cooperation with window **47** which makes it possible to know when the adjustment is correct.

If desired, bolt **52** may be entirely removed if it is desired to feed a liquid to the engine directly through the opening of boss **50** instead of through the entire device as described above.

While there has been described what at present is considered a preferred embodiment of the invention, it will be evident that many changes and modifications may be made therein without departing from its spirit. It is therefore aimed in the appended claims to cover all such changes and modifications which fall within the true spirit and scope of the invention.

What is claimed is:

1. In a liquid feeding device including a vacuum actuated diaphragm and valve for feeding liquid to the cylinders of an internal combustion engine in accordance with the vacuum produced by the operation of said engine, means to simulate load operation vacuum conditions while the engine is idling, said means comprising an outlet in said device for relieving at least a portion of said vacuum so as to subject said diaphragm to correspondingly lower vacuum actuation, a window in said device for observing the variations in liquid feeding as the vacuum actuation on said diaphragm is varied during operation of the device, and threaded adjustment means for said valve so as to substantially predetermine the rates of liquid flow therethrough in accordance with said produced vacuum, said adjustment means being externally accessible so as to be operable during operation of said device.

2. A method of adjusting a liquid flow in a liquid feeding device operating through the application of an engine-produced vacuum while said device is functioning on an engine, which comprises relieving at least a portion of said vacuum so as to subject said device to correspondingly lower vacuum actuation and adjusting the flow of liquid therethrough during and corresponding with such application of lower vacuum actuation.

3. A method of adjusting a liquid flow in a liquid feeding device operating through the application of an engine-produced vacuum while said device is functioning on an engine, which comprises neutralizing a major portion of said vacuum so as to simulate load conditions while the engine is idling and adjusting the flow of liquid through the device pursuant to such reduced vacuum conditions.

4. A feeding device for attachment to an internal combustion engine so as to feed liquid from a source of supply, said device comprising a diaphragm operative for actuation by the vacuum present in the intake manifold of the engine when running, externally accessible valve means connected to said diaphragm so as to produce a larger opening when the engine is operating under load, and a smaller opening when the engine is idling whereby liquid from said source of supply may be fed through an opening of a size commensurate with the speed of the engine, said valve means being manually adjustable substantially externally of said device during operation thereof and whereby the extent of its said openings may be substantially predetermined, means to temporarily relieve said diaphragm from said vacuum during said engine idling speed whereby the response of said diaphragm simulates load or high speed operation of the engine, said relieving means including an air vent for at least partially neutralizing said vacuum and a window in said device for observing the flow of oil through said valve means during relief of said diaphragm from said vacuum.

5. A liquid feeding device according to claim 4 and including an air-tight chamber housing said diaphragm, said air vent communicating with said chamber and being settable to both open and closed positions so that in the closed position thereof said diaphragm is acted upon by the full vacuum from the engine and in the open position thereof, while the engine is idling, the vacuum is partially neutralized so as to simulate a higher speed of engine operation.

6. A liquid feeding device according to claim 5 and including a hollow threaded bolt screwed into said chamber, the hollow of said bolt comprising said air vent, said air vent having an effective diameter of approximately .040 inch.

CLAYTON B. PIERCE.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
160,669	Gray	Mar. 9, 1875
1,883,110	Thompson	Oct. 18, 1932

FOREIGN PATENTS

Number	Country	Date
210,898	Great Britain	Feb. 14, 1924